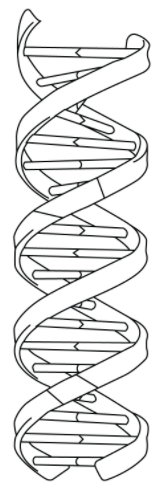
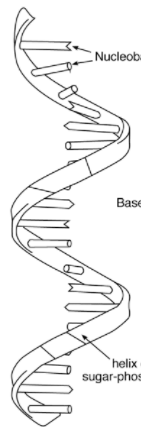
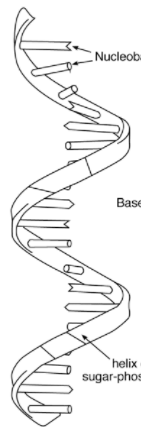
|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Unit 1: Biochemistry** | | | | | | | |
| Name: | | Start: | | | 09/26/17 |  |  |  |
|  | | Unit Test 2: | | | 10/16/17 |  |  |  |
| Period: | | Teacher: Ms. Jost | | | |  |  |  |
|  | |  |  |  |  |  |  |  |
| **Biochemistry Part II** | | Submitted | Resubmit | Correct | Evidence of Learning | Page | Date | Sign-Off |
| **Objective 3:** Explain the double-stranded, complementary nature of DNA as related to its function in the cell. | |  |  |  | **Catalyst: Nucleotide** | 2 |  |  |
|  |  |  | **Activity: Building DNA** | 4 |
|  |  |  | **Notes: DNA and RNA** | 5 |
|  |  |  | **HW: Exploring the Structure of DNA** | 8 |
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**Catalyst 1: Draw and label a nucleotide.**

****

**Catalyst 2: DNA vs. RNA**

****

**Unit 1: Biochemistry**

Start Date: 09/26/2017 Test 2 Date: 10/16/2017

**Objective 3:**Explain the double-stranded, complementary nature of DNA as related to its function in the cell.

*Essential Question:* What is the structure of DNA?

*Essential Question:* What is the structure of RNA?

*Essential Question:* How is DNA replicated?

*“I Can” Statements:*

* Identify the double-helix structure of DNA, with sides composed of alternating phosphate-sugar groups and “rungs” composed of complementary nitrogenous base pairs joined by weak hydrogen bonds
* Match DNA base-pair nucleotides (A-T, G-C) appropriately
* Develop a cause-and-effect model relating the structure of DNA to the functions of replication, transcription, and translation (protein synthesis)
* Compare/contrast DNA and RNA
* Identify the role of DNA replication in the cell cycle (allows daughter cells to have an exact copy of parental DNA)
* Explain that the sequence of nucleotides in DNA can code for proteins, but also encodes tRNA and rRNA and some stretches of DNA that appear to have no function.

**Objective 4:** Explain how DNA and RNA code for proteins and determine traits.

*Essential Question:* What are the roles of mRNA, tRNA, and rRNA in the protein synthesis process?

*“I Can” Statements:*

* Interpret a codon chart to predict the amino acids coded for by a nucleotide sequence.
* Identify the roles of the three types of RNA (tRNA, mRNA, rRNA)
* Explain the connection between nucleotide sequence and the resulting protein (Central Dogma: DNA 🡪 mRNA 🡪 protein)
* Explain the process of protein synthesis
  + Transcription that produces an RNA copy of DNA, which is further modified into the three types of RNA
  + mRNA traveling to the ribosome (rRNA)
  + Translation – tRNA supplies appropriate amino acids
  + Amino acids are linked by peptide bonds to form polypeptides. Polypeptide chains from protein molecules. Proteins can be structural (forming a part of the cell materials) or functional (hormones, enzymes, or chemical involved in cell chemistry).
* Explain how an amino acid sequence forms a protein that leads to a particular function and phenotype (trait) in an organism.
* Explain how cells can responds to their environments by producing different types and amounts of proteins by changing the expression of genes.

**Objective 5:** Explain how mutations in DNA that result from interactions with the environment (i.e. radiation and chemicals) or new combinations in existing genes lead to changes in function and phenotype.

*Essential Question:* What happens when mutations occur in DNA?

*“I Can” Statements:*

* Model how changes in nucleotide sequence (mutations) can alter the resulting protein
* Infer the advantages (injury repair) an disadvantages (cancer) of the overproduction, under production, or production of proteins at incorrect times
* Develop a cause-and-effect model in order to describe how mutations occur: changing amino acid sequence, protein function, phenotype
* Explain that changes in the DNA sequence (mutations) can be deletions, additions, or substitutions
* Explain that only mutations in the sex cells (egg and sperm) or in the gamete produces from the primary sex cells can result in heritable changes in genotype and phenotype

Biology I Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Activity: Building DNA Period: \_\_\_\_ Date: \_\_\_/\_\_\_/\_\_\_

**Directions:** Using the packet of nucleotides, you and your teammates must solve the puzzle of the structure of DNA. Using your understanding of the structure of nucleotides and how to make a polymer, fit the pieces together to make your very own polymer of DNA!

Once your group has successfully assembled a molecule of DNA, answer the following analysis questions:

**1. What two molecules make up the outside, or backbone of your DNA molecule?**

**2. How did you know how to fit the middle pieces together?**

**3. Which way did you have to turn the nucleotides to get them to fit together?**

**4. What do you notice about the direction each side of the molecule is facing?**

**5. Draw your DNA molecule in the space below and label the different components:**

Biology

Objective 3 Notes: Structure of DNA

**1. The Central Dogma of Molecular Biology**

**DNA**

**mRNA**

**proteins**

**2. Review of Proteins**

* Proteins do \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_!
  + Provide structure for cells; Act as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, pigmentation, transport \_\_\_\_\_\_\_\_\_\_\_\_\_\_, ect.
* Made of amino acids connected by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ bonds
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ determines \_\_\_\_\_\_\_\_\_\_\_\_\_
* The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in a polypeptide chain determines the type of protein

**Give an example of a situation where a protein’s shape might be altered/changed. What happens to the function of that protein when the shape is changed?**

**3. DNA**

* DNA stands for \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* The function of DNA is\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Draw a quick sketch of a molecule of DNA:**

**4. Structure of DNA**

* DNA is referred to as a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + Looks like a twisted ladder.
* Made up of\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ linked together by weak \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ bonds

**5. Chemical Composition of DNA**

* Structure of a nucleotide:
  + Made of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* Nucleotides held together by \_\_\_\_\_\_\_\_\_\_\_\_ hydrogen bonds

**6. Nitrogen-containing Bases**

* + Purines (have \_\_\_\_\_\_ carbon rings)
    - Adenine (A)
    - Guanine (G)
  + Pyrimidines (have \_\_\_\_\_\_ carbon ring)
    - Cytosine (C)
    - Thymine (T) in DNA
    - Uracil (U) in RNA

**7. Who discovered DNA?**

* Most of the credit goes to James \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and Francis \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* April 2, 1953
* Others who were essential to the discovery include:
  1. Erwin Chargaff-
  2. Maurice Wilkins-
  3. Rosalind Franklin-

**Why wasn’t Rosalind Franklin also awarded the Nobel Prize?**

**8. Chargaff’s base pairing rules**

* The bases pair up like pieces of a puzzle.
* Chargaff’s Rules:
  + Adenine — \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (\_\_\_\_\_\_\_\_\_\_\_ bonded)
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ — Cytosine (\_\_\_\_\_\_\_\_\_\_\_\_\_ bonded)
* Joined by \_\_\_\_\_\_\_\_\_\_\_\_\_\_ bonds

**9. What is RNA?**

* RNA is Ribonucleic Acid.
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_ stranded template of DNA.
* Function: to carry the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ out of the nucleus to ribosomes in the cell

**10. Types of RNA**

* There are three types of RNA that help translate the DNA code into proteins:
  + mRNA (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ RNA): carries the DNA code out of the nucleus
  + rRNA (ribosomal RNA): RNA that makes up ribosomes
  + tRNA (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ RNA): brings the proper \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to the mRNA

**11. Differences between DNA and RNA**

|  |  |
| --- | --- |
| **DNA** | **RNA** |
|  |  |

****

**a. Label the diagram of DNA below. Include the following:**

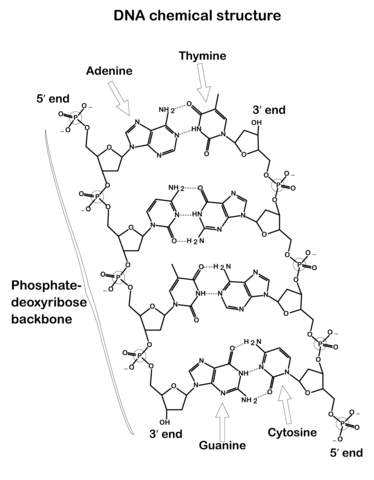
* At least 1 of each nitrogen base
* A sugar
* A phosphate
* The bonds between bases

**b. Circle 1 nucleotide**

**c. Draw arrows to indicate the direction on each strand**

**Homework: Exploring the Structure of DNA**

Deoxyribonucleic acid, or DNA, is the molecule found in all cells that provides the blueprint for life. Made up of a universal code of alternating nitrogen bases (Adenine, Cytosine, Thymine and Guanine) DNA contains all an organism’s genetic instruction. Formed by millions of nucleotides, spiraling in a double-helix, the remarkable structure of DNA is crucial for its function.



1. What do the letters DNA stand for? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. What type of biomolecule is DNA?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3..  DNA is a polymer, which means that is made up of many repeating single units (monomers).  What are

the monomers  called? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

4. What elements appear in a molecule of DNA?

5.  The “backbone” of the DNA molecule is made up of two components, what are these?

a. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

6.  There are four different variations of these monomers (four different bases), what are the names of  those bases?

a. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

c. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

d. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

7. Which two bases pair together to complement each other? (Hint: There are four bases but they each only match with one other base)

8. Color the picture of the DNA molecule to show the pairing pattern of the nitrogen bases.

Biology Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Lab: Edible DNA Period: \_\_\_\_ Date: \_\_\_/\_\_\_/\_\_\_

**Objective 3:** Explain the double-stranded, complementary nature of DNA as related to its function in the cell.

**Introduction:**

DNA provides the instructions for building and operating all living things. The DNA instructions are divided into segments called genes. Each gene provides the information for making a protein, which carries out a specific function in the cell.

A molecule of DNA (Deoxyribonucleic Acid) is composed of two backbones and four types of chemical bases. The backbone is formed by a chain of alternating phosphates and sugars. Each sugar molecule in the backbone provides an attachment site for one of the chemical bases. The four types of chemical bases are: adenine, thymine, cytosine and guanine. They usually are represented by their first letters: A, T, C and G. The bases form pairs in a very specific way: A always pairs with T, and C always pairs with G. A pair of bases is connected by hydrogen bonds. Each base in the pair is also connected to a sugar compound in the DNA backbone.

A DNA molecule is often compared to a ladder, with the two backbones forming the sides of the ladder and the base pairs forming the steps, or rungs. However, instead of a straight ladder, DNA looks like a twisted ladder, known as a double helix (“double” for the two backbones). The DNA sequence is the consecutive order of bases on one side, or strand, of the twisted ladder. The other strand has a complementary sequence determined by the base pairing rules.

The specific matching of the base pairs, A with T and C with G, provides a way for exact copies of DNA to be made. This process is called DNA replication. In DNA replication, the double helix ladder is untwisted and the two strands are separated by breaking the hydrogen bonds between the base pairs. Next, two new strands are made by reading each side of the DNA ladder, one step (base) at a time. At each step, the matching base fills in (with its associated sugar and phosphate) to complete the rung and lengthen the new DNA strand. When the process is complete, there are two identical DNA double helices, each containing one original and one new strand.

DNA replication is an important part of the cell division process. Before a cell divides, it first duplicates its DNA so that the new cell will have the same genetic information. The specific base pair matching during replication ensures that exact DNA copies are made.

**Task:**

Your task is to use the following materials and procedure to construct an edible model of DA. When you are finished, used toothpicks and tape to label one of each of the chemical bases.

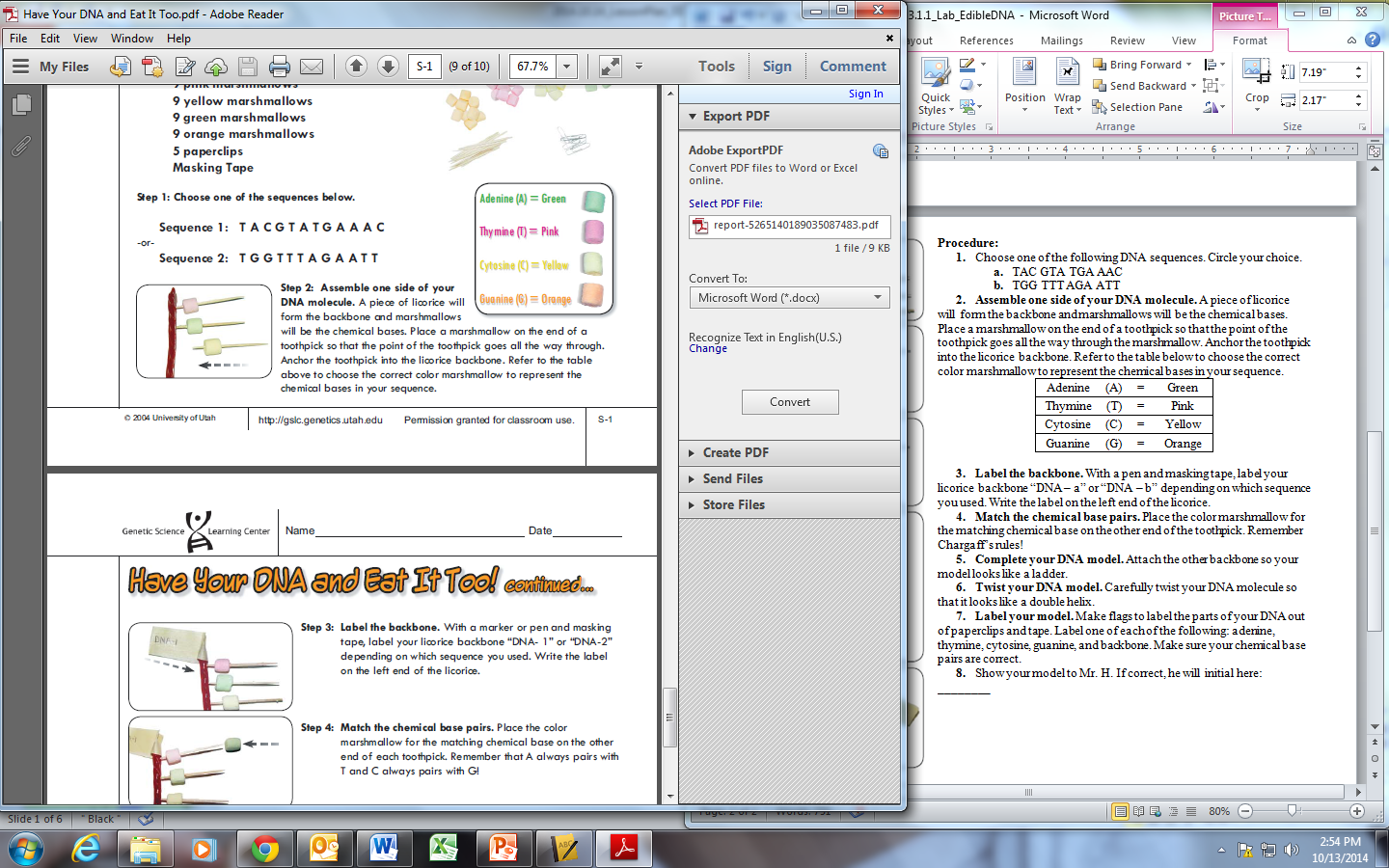
**Materials:**

* Licorice
* Toothpicks
* Pink marshmallows
* Yellow marshmallows
* Green marshmallows
* Orange marshmallows
* Paperclips
* Masking tape
* Scissors

**Procedure: Building a DNA Molecule**

**1.** Use the following DNA sequence to create your model:

* + 1. **TAC GTA TGA AAC**

1. **Assemble one side of your DNA molecule.** A piece of licorice will form the backbone and marshmallows will be the chemical bases. Place a marshmallow on the end of a toothpick so that the point of the toothpick goes all the way through the marshmallow. Anchor the toothpick into the licorice backbone. Refer to the table below to choose the correct color marshmallow to represent the chemical bases in your sequence.

|  |  |  |  |
| --- | --- | --- | --- |
| Adenine | (A) | = | Green |
| Thymine | (T) | = | Pink |
| Cytosine | (C) | = | Yellow |
| Guanine | (G) | = | Orange |

1. **Label the backbone.** With a pen and masking tape, label your licorice backbone “DNA – a” or “DNA – b” depending on which sequence you used. Write the label on the left end of the licorice.



1. **Match the chemical base pairs.** Place the color marshmallow for the matching chemical base on the other end of the toothpick. Remember Chargaff’s rules!



1. **Complete your DNA model.** Attach the other backbone so your model looks like a ladder.



1. **Twist your DNA model.** Carefully twist your DNA molecule so that it looks like a double helix.



1. **Label your model.** Make flags to label the parts of your DNA out of paperclips and tape. Label one of each of the following: adenine, thymine, cytosine, guanine, and backbone. Make sure your chemical base pairs are correct.
2. Show your model to Ms. J. If correct, she will initial here: \_\_\_\_\_\_\_\_
3. **Challenge:** Considering what you know about the structure of RNA, use your candy pieces to construct a molecule of RNA.
4. Show your model to Ms. J. If correct, she will initial here: \_\_\_\_\_\_\_\_

**Analysis Questions:**

1. Explain the **double-stranded** nature of DNA.

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

1. Explain the **complementary** structure of DNA.

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

1. What did the toothpicks in your model represent?

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

1. What did the twizzlers in your model represent?

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

1. What did the colored marshmallows in your model represent?

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

1. Explain how the specific pairing of adenine with only thymine and guanine with only cytosine helps preserve the structure of the DNA molecule.

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

1. Explain how RNA is involved in the passing of the DNA code to the rest of the cell.

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Biology I Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Foldable: DNA & RNA Period: \_\_\_\_ Date: \_\_\_/\_\_\_/\_\_\_

**Objective 3:** Explain the double-stranded, complementary nature of DNA as related to its function in the cell.

Materials needed:

-colored sheet of paper from Ms. J

-scissors

-glue

1. Fold the colored sheet of paper in half like a hotdog.
2. You need to create 3 flaps. This can be done by making 2 cuts.
3. Label the flaps like the diagram below. (Dotted lines represent where cuts should be made.)
4. Under the DNA flap, write 4 points that are specific to DNA.
5. Under the RNA flap, write 4 points that are specific to RNA.
6. Under the similarity flap, write 3 similarities between the 2 nucleic acids.
7. Glue the foldable over the picture below.

DNA

Similarities

RNA

Biology I Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Venn Diagram: DNA & RNA Period: \_\_\_\_ Date: \_\_\_/\_\_\_/\_\_\_

**Objective 3:** Explain the double-stranded, complementary nature of DNA as related to its function in the cell.

**Complete the Venn diagram below using the following words or phrases:**

* A kind of nucleic acid
* Adenine (A)
* Composed of nucleotides
* Contains sugars
* Contains nitrogenous bases
* Cytosine (C)
* Deoxyribose sugar
* Double stranded
* Guanine (G)
* Inherited genetic information
* Phosphate groups
* Remains in the nucleus
* Ribose sugar
* Single stranded
* Thymine (T)
* Travels between nucleus and cytoplasm
* Uracil (U)

**DNA RNA**

**Catalyst: History of the Structure of DNA**

Read the article below and answer the questions on the following page.

**Watson and Crick describe structure of DNA --1953**

In the late nineteenth century, a German biochemist found the nucleic acids, long-chain polymers of nucleotides, were made up of sugar, phosphoric acid, and several nitrogen-containing bases. Later it was found that the sugar in nucleic acid can be ribose or deoxyribose, giving two forms: RNA and DNA. In 1943, American Oswald Avery proved that DNA carries genetic information. He even suggested DNA might actually *be* the gene. Most people at the time thought the gene would be protein, not nucleic acid, but by the late 1940s, DNA was largely accepted as the genetic molecule. Scientists still needed to figure out this molecule's structure to be sure, and to understand how it worked.

In 1948, Linus Pauling discovered that many proteins take the shape of an alpha helix, spiraled like a spring coil. In 1950, biochemist Erwin Chargaff found that the arrangement of nitrogen bases in DNA varied widely, but the amount of certain bases always occurred in a one-to-one ratio. These discoveries were an important foundation for the later description of DNA.

In the early 1950s, the race to discover DNA was on. At Cambridge University, graduate student [Francis Crick](http://www.pbs.org/wgbh/aso/databank/entries/bocric.html) and research fellow James Watson (b. 1928) had become interested, impressed especially by Pauling's work. Meanwhile at King's College in London, Maurice Wilkins (b. 1916) and [Rosalind Franklin](http://www.pbs.org/wgbh/aso/databank/entries/bofran.html) were also studying DNA. The Cambridge team's approach was to make physical models to narrow down the possibilities and eventually create an accurate picture of the molecule. The King's team took an experimental approach, looking particularly at x-ray diffraction images of DNA.

In 1951, Watson attended a lecture by Franklin on her work to date. She had found that DNA can exist in two forms, depending on the relative humidity in the surrounding air. This had helped her deduce that the phosphate part of the molecule was on the outside. Watson returned to Cambridge with a rather muddy recollection of the facts Franklin had presented, though clearly critical of her lecture style and personal appearance. Based on this information, Watson and Crick made a failed model. It caused the head of their unit to tell them to stop DNA research. But the subject just kept coming up.

Franklin, working mostly alone, found that her x-ray diffractions showed that the "wet" form of DNA (in the higher humidity) had all the characteristics of a helix. She suspected that all DNA was helical but did not want to announce this finding until she had sufficient evidence on the other form as well. Wilkins was frustrated. In January, 1953, he showed Franklin's results to Watson, apparently without her knowledge or consent. Crick later admitted, "I'm afraid we always used to adopt -- let's say, a patronizing attitude towards her."

Watson and Crick took a crucial conceptual step, suggesting the molecule was made of two chains of nucleotides, each in a helix as Franklin had found, but one going up and the other going down. Crick had just learned of Chargaff's findings about base pairs in the summer of 1952. He added that to the model, so that matching base pairs interlocked in the middle of the double helix to keep the distance between the chains constant.

Watson and Crick showed that each strand of the DNA molecule was a template for the other. During cell division the two strands separate and on each strand a new "other half" is built, just like the one before. This way DNA can reproduce itself without changing its structure -- except for occasional errors, or mutations.

The structure so perfectly fit the experimental data that it was almost immediately accepted. DNA's discovery has been called the most important biological work of the last 100 years, and the field it opened may be the scientific frontier for the next 100. By 1962, when Watson, Crick, and Wilkins won the Nobel Prize for physiology/medicine, Franklin had died. The Nobel Prize only goes to living recipients, and can only be shared among three winners. Were she alive, would she have been included in the prize?

Citation: "Watson and Crick Describe Structure of DNA 1953." *PBS*. PBS, n.d. Web. 19 Sept. 2016.

**Response Questions:**

1. What contributions to the discovery of DNA was made by the following people:

a. Oswald Avery:

b. Linus Pauling

c. Erwin Chargaff

2. What approach to figuring out the structure of DNA did the Cambridge team take? What approach did the King’s team take?

3. Considering Rosalind Franklin’s x-ray crystallography photos as a key link in the puzzle of the structure of DNA, many argue that she was deserving of the Nobel Peace Prize, not Watson and Crick. What do you think? Justify your answer.

**Activity: Replication Video**

Watch the following video and answer the questions below. It is helpful to watch with captions on!

<https://www.youtube.com/watch?v=TNKWgcFPHqw>

1. What is the shape of DNA?

2. Each strand is made up of a set of \_\_\_\_\_\_\_\_ chemical bases represented by the letters \_\_\_\_\_\_, \_\_\_\_\_\_, \_\_\_\_\_\_, and \_\_\_\_\_\_\_.

3. What does it mean for the strands to be complementary?

4. What is the first step in DNA Replication?

5. This unzipping is done by an enzyme called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and results in the formation of a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

6. What does primase do to start the process?

7. What does DNA Polymerase do?

8. Why can’t the “lagging” strand be made continuously?

9. The DNA Polymerase makes the new DNA strand in small chunks called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

10. What is the role of DNA ligase?

11. Why is DNA replication considered to be “semiconservative”?